NEWSLETTER

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NEWS & VIEWS

SUBSCRIPTIONS NOW DUE

It's that time of the year again! Accompanying this issue of the Newsletter is a request for your 1982/83 subscription to the Society. Please get a cheque off today and save our hard working Secretary/Treasurer the arduous task of chasing up your subs. later in the years. Remember, if you wish to receive the 1983 volume of the **Australian Journal of Marine and Freshwater Research** at the special price of $18.00 you must let Margaret Hart have your augmented subscription before the end of the year. It is only possible for the Society to place one set of orders for A.J.M.F.R. - if you are late with your payment you will miss out!

BIBLIOGRAPHY OF AUSTRALIAN LIMNOLOGY

The Executive Committee of the Society has agreed to publish an on-going **"Bibliography of Australian Limnology"** in the Newsletter. This bibliography will list published works on all aspects of pure and applied Australian limnology.

The bibliography will commence with works published in 1982. Russell Tait will compile this bibliography. Please send a reprint (or a full citation if a reprint is not available) of any limnological work you or your colleagues publish or, if published by others, you think may have been missed. As well as book and journal articles it would be very useful to include reports of government organisations, etc. These often contain useful information but their existence is known to only a few people. Send information to:

Dr. Russell Tait,
Esso Australia Ltd.,
Rundle Project Group,
P.O. Box 1189,
Gladstone, Queensland 4680.

APPEAL FOR OLIGOCHAETES

Peter Nuttall is working on the taxonomy of the Australian aquatic oligochaetes. He would like to receive specimens from all localities. Habitat information should accompany specimens. The oligochaete worms are poorly known in Australia so please help Peter in his work.

Peter Nuttall,
Dandenong Valley Authority,
208 Princes Highway,
Dandenong, Victoria 3175.

KEY TO LARVAE OF VICTORIAN ZYGOPTERANS

As well as having an interest in worms, Peter Nuttall has also put together an excellent illustrated key to the larval zygopterans of Victoria. Some members received copies at the Griffith Conference. Peter has a limited supply of this key for distribution - contact him at the address given above.

SALINE LAKES CONFERENCE IN CANADA

Bill Williams writes:
"The recent Second International Symposium on Athalassic Saline Lakes was held in Canada, 24-28 June, under the sponsorship of Dr. U.T. Hammer, General Chairman. Australians who attended this were Bill Williams, Patrick De Deckker, Brian Timms and Margaret Brock. Each presented a paper. In addition two other papers were presented on Australian salt lake work (by two Americans). Following the formal meeting there was a field trip to Saskatchewan salt lakes which was also well attended."

DEATH OF JOACHIM ILLIES

Many members will be saddened to learn of the death of Professor Joachim Illies on 3 June 1982. His works on stream classification and stoneflies are well known to many Australian limnologists.

WELCOME TO NEW MEMBERS

The following have recently joined the Society: Ronald Patra, Maureen O'Keefe, Kelly Ough, Joanna Day and Mark Perry (all from Monash University); Peter Cary (CSIRO, Griffith), Bruce Weston (Chisholm Institute); Louis Bennett (CSIRO Editorial Office, Melbourne); Shawn Sowerbutts (South Australia); Ian Brown (Torwood, Queensland); David Seamer (Linfield, N.S.W.) and Stuart Mitchell (University of Otago, N.Z.). Our welcome to all of them!

SUCCESSFUL CONFERENCE AT GRIFFITH

The Society held its Annual Conference at Griffith, N.S.W. in May 1982. The Conference was very successful on all fronts. The standard of papers was very high. Ten papers were presented for the Student Prize; the award was won by Jane Roberts from the Department of Botany, University of Adelaide, for her paper "Productivity and demography in Typha orientalis". The abstracts of the papers presented at the Conference are given elsewhere in this Newsletter. The Society is very grateful to Alan Chick and Max Finlayson for their marvelous efforts as the local organizers of the Conference.

MEETING OF TRICHOPTERA WORKERS

It is hoped to organize a meeting of caddis-fly worker for later this year. The present concept is that the meeting will follow the format of the A.S.L. Annual Conference with arrival and registration on Friday evening, presentation of papers and discussions on Saturday, and sampling/visits on the Sunday.

The venue will probably be a Victorian country location with access to an interesting Trichoptera fauna. The weekend of 4-5 December 1982 has been suggested as being suitable. Accommodation reservations will probably have to be finalised by early September, with notices and registration forms distributed to interested persons around mid-August. Persons wishing to receive registration forms should contact John Dean, c/- MMBW Laboratories, Box 4342, Melbourne Victoria 3001 (telephone 03 615 4391) as soon as possible.

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1982 PRESIDENTIAL ADDRESS

Frank Burns, the Society's President for 1981-82, delivered his Presidential Address at the Griffith Conference; the Address is printed below.

ARE THE RESULTS OF WATER RESEARCH BEING FULLY UTILISED?

"I listened with interest to the Presidential Address last year putting the case for Australia to have a National Institute of Freshwater Research, and I agree with everything that was said.

I have read with interest the report of the recent A.W.R.C. Working Group on Water Research Policy in Australia showing the urgent need for more attention to water research, and I agree with everything they say also.

In fact I agree that there is a lot of work to be done in Australia, researching into the many limnological and water supply peculiarities of our own country which nobody else is going to do for us - we will have to do it ourselves.

However, as a water supply engineer, I feel frustrated, and the reason for my frustration may well be the reason for the deplorable lack of water supply engineers in the Australian Society for Limnology and other such research oriented societies.

I ask myself the question "Are water supply engineers going to be able to use the results of all this water research?" Ask anyone this question and the answer will come straight back "Of course they will. They run the water authorities don't they? It's their responsibility to look after our water, and make sure that the latest technological developments are utilised in giving us the best water possible."

"Oh!" I say, "Is that so? - and what are they going to use for money? They don't make it. Water is not like gold with a value of its own. Try selling someone a cup of cold water." The fact of the matter is that all the

money spent by the water authorities in putting the results of water research into action have to come from the public - from you and I.

Let us look at what you and I (the public) think about the importance of all this. Let us look at a few of the things a normal sort of household spends it's money on each year.

	$
Housing (We must impress the neighbours)	4000
Food (Not including the parties)	3000
Car (We must be mobile)	2000
Electricity (Essential to run the T.V.)	400
Oil (To keep us warm by the T.V.)	400
Telephone (Mainly for the teenage daughter)	200
Sewerage (A real essential)	150
Water (Why do they charge us that much?)	70

What does this tell us about how we rate the importance of our water authorities putting the results of water research into action? A paltry $70 per year! We are willing (very reluctantly) to give our water authorities about ¼% of our yearly income to maintain storages, pipelines, house services, and all the other things required to bring our water to us. Then we demand that they also employ the technical staff, and put in the technical equipment to bring the latest advances in water research to us.

"Oh" you say, "but we pay about $5000 per year income tax to the Commonwealth Government (Also very reluctantly) It's up to them to do something about it. It's not our responsibility."

Supposing we could convince the Commonwealth Government they should spend more on water, at the expense of education, social services, defence, and all the other essentials, what would be the result? They are not a water authority directly involved in water supply operations. All they could do would be to make more money available for research (which the water author-

ities cannot afford to implement) or for capital works (which the water authorities cannot afford to operate and maintain.

Why can't the water authorities afford to implement the results of research, or pay for additional operation and maintenance? Because these have to be paid from revenue, which has to come from you and I, the rate payers, and we have so many other more important things to spend our money on.

One of the very significant points highlighted by the recent A.W.R.C. Working Group on Water Research in Australia was that the Australian water industry is now coming to the end of the development era, and the emphasis now has to be more on management and maintenance of the works it has created.

The water authorities can truly be proud of their achievements during this development era. In this, one of the driest continents, we are able to supply the highest per capita consumption in the world. We have led the world in water legislation vesting all water rights in the crown. We commenced systematic river gauging well before most other developed countries, and our design and construction of the dams, channels. pipelines, and other works to utilise the water is second to none.

However the scene is now changing rapidly. There is more awareness and concern for our environmental responsibilities. People want water they can drink, and not just spray on the garden. They want reservoirs they can enjoy, without having to hold their nose to keep out the smell of dead fish, algae, and anoxic water.

Water research is providing the water authorities with the knowledge and technology to meet these new demands; but who is providing the money to implement them? It is no longer sufficient for a water authority to just employ a man to turn valves on and off, and keep up with the paper work. If they are to put the results of water research to work, they must employ higher trained staff equipped with the necessary equipment. This means a major difference in funding. Capital works are funded from loans for which there are all sorts of Government assistance, such as subsidised interest. However operation, management, and maintenance of works have to be funded from revenue - the money paid directly by you and I in rates. This revenue money is far

more difficult to come by than loan money, because of the political reluctance to increase water rates created by our own public opposition to spending more on our water.

During this conference I will be describing the work I carried out this summer for a small Victorian waterworks trust in aerating their reservoir to improve the water quality. The previous summer their water had been undrinkable due to anoxic conditions and algal blooms. However this summer it was kept in excellent condition throughout by aeration, commencing in the spring and continuing intermittently as judged necessary by regular monitoring of the reservoir. This was the direct application of the results of research I carried out under an A.W.R.C. research grant, and it indicates the sort of benefits water research can bring to you and I, the consumers.

However, it is unlikely that this small waterworks trust will be able to afford to adopt this water quality control as a regular practice. There is no problem in purchasing the compressor (This is capital works) or in running it (This only costs $5 per week). The real problem is in paying for the technical staff to carry out the necessary regular monitoring of the reservoir, to decide when and how long to aerate. This is the money which has to come from revenue - from you and I, the rate payers.

We are therefore in the ludicrous position where we have the technology to obtain the good quality water we demand, but are unwilling to pay for it to be implemented, and just sit back asking for somebody else to provide money to develop more technology.

I am sure this is only a temporary situation, and eventually we (the public) will realise our obligations, and demand realistic pricing and charging of our water services, which will enable our water authorities to serve us with the same distinction in this new era as they have in the past. With the increase in their ability to implement the results of water research will come an increased demand for water research, and the full utilisation of the many talents represented here at our 21 st Annual Conference of the Australian Society for Limnology."

1982 CONFERENCE PAPERS

The effect of land use in catchments on aquatic systems:

Keynote address

A.J. McComb, Department of Botany, The University of Western Australia
Nedlands WA 6009

Attention will be directed to the Peel-Harvey Estuarine System, which has limited exchange with the ocean, and is fed by three rivers - the Murray, the Serpentine, and the Harvey. Since the mid 1960's large accumulations of macroalgae (including *Cladophora*) have fouled the beaches in Peel Inlet and, especially in the last few years, massive blooms of the blue-green *Nodularia* have occurred, mainly in the Harvey. Evidence is presented that, although these nuisance algae grow best in the warmer months, the nutrients which maintain them are derived from the rivers which flow only during a limited period each winter. The Harvey river, with a coastal plain catchment, contributes much of the phosphorus. Nutrient loads are presented for different sub-catchments, soil types, and land use. The role of agriculture in bringing about eutrophication in this and other systems will be explored.

Limnological Consequences of Industrial and Urban Development

Keynote address

D.W. Connell, School of Australian Environmental Studies,
Griffith University, Brisbane

In the last 10 to 15 years, the objectives of water management in Australia have undergone considerable change. Previously the purpose of water management was to provide adequate water of good quality for domestic, agricultural and industrial use. Today, in addition to these uses, water quality management aims to provide suitable water for recreation and to conserve aquatic life. These new objectives present a more difficult problem since standards in recreation and conservation are difficult to define.

There is a dependence by water management authorities in Australia on water quality standards and data developed in Europe and North America. These may be applicable in many parts of the country but in other areas differences in ambient water temperatures and seasonal patterns of rainfall indicate that they may be inappropriate.

The management of water is substantially in the hands of State and local government bodies. However there is an urgent need for co-ordination and co-operation at a national level to achieve adequate level of research into peculiarly Australian requirements in water management.

A National Water Research Institute is needed which can be guided by a national consultative body drawn from managers, researchers, etc, so that there is a representation of different regions throughout the country. A funding scheme based on water users, akin in principle to research levies on wheat and wool, should be developed.

In this way, it may be possible to provide adequate and good quality water for multiple uses for a steadily expanding population and industry.

The impact of mining on freshwater ecosystems

Keynote address

T.P. Farrell, CRA Limited, Melbourne, Vic.

Mining can have a considerable environmental impact which extends far beyond the boundaries of the operation itself. This is particularly true when emissions into freshwater ecosystems are considered. However mining and the associated processing of minerals has been taking place for some time without extensively devastating any biological systems. The natural resilience of ecosystems has long been overlooked, and the concepts of contamination and pollution, which is the excess contamination over the capacity of the ecosystem to absorb it, are discussed.

The environmental impact of some of the more dangerous contaminants from mining is discussed, and some examples, both good and bad, of Australian mining are presented.

The role of the freshwater biologist in determining and reducing the environmental impact of mining operations is also discussed.

Salinity trends in Lake Moondarra, a water supply impoundment in North-West Queensland

A. McCredie, Mount Isa Mines Ltd., Mount Isa.

Lake Moondarra, a water supply impoundment in North-West Queensland has increased in total dissolved solids from a historical level of about 200 mg/l to a current level of 300 mg/l, ranging up to 400 mg/l during dry low lake level periods.

The dam's spillway was raised by 1.52 m in 1973, and this has been primarily responsible for the change in the total dissolved solids level, although it was not initially evident due to a series of exceptionally wet years during which the lake regularly overflowed. The raised spillway increased the maximum volume held by the lake from 79 million m^3 to 107 million m^3, and the maximum surface area of the lake from 17.2 km^2 to 23.8 km^2.

Rifle Creek Dam, a small water supply impoundment, in the headwaters of the Lake Moondarra catchment has a similar overflow frequency to that of Lake Moondarra, but total dissolved solids there are only about 100 mg/l. The reasons for this lie in the different geology, and land use of the Rifle Creek catchment, and its relatively greater volume/surface ratio, which reduces the relative amount of evaporation.

The Lake Moondarra situation is being examined to determine whether the salinity has stabilised at the current acceptable level. If dissolved solids continue to rise, it may be necessary to lower the spillway, or implement land use controls in order to prevent the build-up of unacceptable levels of dissolved solids.

Stoichiometric distances of some New South Wales waters, from sea water and fresh water.

Edwin A. Scribner, N.S.W. State Fisheries, P.O. Box N 211. Grosvenor St, N.S.W. 2000.

The concept of stoichiometric distance from sea water, as a Euclidean metric similarity measure for major ion concentrations in water was introduced by Buckney (1976). It has been applied to the waters of twenty five reservoirs in eastern New South Wales. As these waters are mainly bicarbonate dominant (as opposed to the chloride dominance in many waters of arid or semi-arid areas, i.e. most of Australia), the stoichiometric distances from Livingstone's (1963) world average fresh water were also calculated.

The results show a clear pattern. Most waters examined were much nearer fresh water than sea water; a few were nearer sea water than fresh water; while one was equidistant from the two. These attributes reflect the major processes of ion dissolution, as described by Gibbs (1970). Those nearer fresh water are dominated by rock dissolution, and those nearer sea water by atmospheric precipitation. There is geographic as well as chemical evidence for these conclusions. The one water source with stoichiometry equidistant from sea water and fresh water (Rylstone reservoir) is probably influenced by groundwater intrusion, the salt in this groundwater being of ancient marine origins (Muir and Johnson 1979).

Phantom midges *(Chaoborus sp.)* in Myponga Reservoir and water distribution system : the effects of aeration.

P.J. Suter, State Water Laboratories, Engineering and Water Supply Department Bolivar S.A.

The air curtain installed in Myponga Reservoir did not function to keep *Chaoborus* larvae away from the outlet tower, but by lowering the depth of the thermocline it actually displaced the high concentrations of phantom midge larvae away from the offtake valves. During 1980 the offtake valve 3 was in the hypolimnion where the phantom midge larvae were concentrated, but during the period of operation of the air curtain, the valves (3 & 4) were always in the epilimnion and therefore physically separated from the concentration of *Chaoborus* larvae.

Therefore, the air curtain had the desired effect; of reducing the number of phantom midges entering the distribution system.

Water quality control in Little Bass Reservoir

Frank L Burns, Consulting Engineer, 22 Fiander Avenue, Glen Waverley.

Little Bass Reservoir is a small town supply storage, of 240 ML capacity and a 10 m maximum depth, serving the towns of Poowong, Loch, and Nyora in Gippsland, Victoria.

In the 1980/81 summer algal problems and anoxic water due to thermal stratification made the water completely undrinkable. Emergency aeration with a 100 CFM compressor gave some relief from these problems late in the summer.

This summer, 1981/82, the reservoir has been kept destratified throughout by intermittent operation of a 25 CFM electric powered compressor, at a cost of about $5 per week, which has kept the water in excellent condition. The results of this very economical water treatment will be presented, and the limnological reasons for its success will be discussed.

The success appears to be associated with the production of a healthy and active benthic population carrying out a waste stabilisation role. This throws doubts on the wisdom of the conventional water management practice of using copper sulphate to reduce algae, since this could be reducing the beneficial benthic population also. It was found possible to control the algae by aeration alone.

The Conservation status of Australian Inland Waters and their biota : A discussion paper.

W.D. Williams, Dept. of Zoology, University of Adelaide.

A great deal remains to be done to ensure the adequate conservation of Australian aquatic environments and their biota. To focus attention on this distressing situation the paper surveys the present conservation status of the aquatic biota and various environments. By doing this it is hoped that the attention of the Society will be drawn to the urgent need for a factual inventory. Individual copies of the paper are made available to participants at the Congress to stimulate discussion. Comments are welcome and may be given directly to the author or send later by mail.

Gas exchange in the freshwater/land crab *Holthuisana transversa*

P. Greenaway, School of Zoology, U.N.S.W.

Holthuisana transversa is an amphibious crab able to breathe water or air with equal facility. The mechanisms of ventilation in air and water will be considered and blood gas physiology discussed.

Calcium storage in premoult *Holthuisana transversa* (Sundathelphusidae)

Stephen Sparkes and Peter Greenaway, School of Zoology,
University of N.S.W.

H. transversa, unlike most marine and freshwater crustaceans retains much of its total body calcium through the moult. Approximately 60% of total body intermoult calcium is conserved compared to about 10% in other crustaceans. This difference between species with regard to calcium conservation will be related to their mode of life.

The major site for calcium storage in *H. transversa* is the blood. This involves a remarkable rise in blood calcium to a maximum of 1.24 mol/L, just prior to moult. This represents a 96 fold increase in total blood calcium. Ionized calcium in the blood remains at normal intermoult levels.

A new method for separating benthic arthropods from detritus.

L.A. Barmuta, Department of Zoology, Monash University,
Clayton, Vic., 3168.

Benthic arthropods were sorted from stream bed detritus (size range 300-1000 µm) with a phase-separation technique using kerosine and 70-90% ethanol. 86.78 ± 2.66% (95% C.I.) of the arthropods were retained at the interface, and better efficiences have been obtained by treating the same sample twice. The low variability of extraction shows that this method is potentially useful for standardizing the efficiency of sorting in projects where more than one sorter is employed.

Reproductive biology of the freshwater mussel, *Velesunio ambiguus*.

Jane Moller, Dept. of Zoology, University of Adelaide.

The freshwater mussel *Velesunia ambiguus* (Philippi) is widespread in eastern Australia, being found in rivers, creeks, lakes and some dams. *V. ambiguus* has an interesting life cycle for several reasons:

- Female mussels incubate eggs in specialized 'marsupial gills'.
- the larval stage (glochidium) is parasitic on fish,
- while attached to the fish, the glochidium metamorphoses to a juvenile mussel stage,
- normally *V. ambiguus* is considered monoecious but occasional hermaphrodites have been found in the Point Sturt population. These hermaphrodites are functional since the essential marsupial gills are present.

Creeks in the Westernport catchment

R. Gaymer, Victoria College, Rusden Campus, Environmental Studies Dept.

Six creeks with catchments totalling about half the land area of the Westernport catchment were studied for 16 months from April 1980. The study aimed at providing data for the Victorian Ministry for Conservation to complement their extensive work on the Bay. Land use, vegetation, recreation and planning, water quality and aquatic life were the main aspects studied.

About 380 species of aquatic animals were collected from 39 sites, which ranged from undisturbed forest streams through agricultural and urgan areas to estuarine creeks.

A computer analysis of the data is being attempted. The conditions of the streams and the distributions of some of the common animals will be discussed.

Instar discrimination in Plecoptera

Cathy Yule, Zoology Dept. Monash University.

The discrimination of instars in Plecoptera, and indeed in all arthropods, has long been a cause of difficulties and many different methods have been proposed for this purpose. Flexibility in developmental rate and the number of instars within a population (as a result of genetic and environmental factors) frequently precludes the determination of a specific number of instars for a species. This problem is exacerbated because the various methods used for instar determination may give conflicting results.

In this investigation, a population of *Dinotoperla* (Plecoptera = stoneflies) was studied in a temporary pond in Victora. The nymphs were found to undergo synchronous development and so the seven instars could be clearly discerned. In the light of this, the methods which have been most commonly used for the discrimination of instars in insects and crustacenas were tested and an evaluation made of their accuracy and usefulness.

Variation in the Genus Daphnia in Australia

John Benzie, Australian National University, Canberra.

Approximately fifty populations of Daphnia have been screened for morphological and enzymic variation. The allozynic data have demonstrated clearly that the Daphnia carinate complex consists of more than one species, but their cyclomorphosis (a seasonal change in head size) occurs in each and is not simply the result of a seasonal succession of species.

Some adsorption characteristics of seston and aufwuchs

Kathleen H. Bowmer, CSIRO Division of Irrigation Research
Griffith, N.S.W.

The absorption of three contrasting compounds (terbutryn, glyphosate and diquat) by seston (suspended particulate matter) in irrigation water was investigated using the Freund and Langmuir equations to aid interpretation. Terbutryn is a weak base, diquat is cationic, and glyphosate is anionic at neutral pH. Seston was extremely reactive in adsorbing all three compounds, and particulate matter associated with aufwuchs on *Elodea canadensis* Rich. effectively inactivated diquat by adsorption. Results have application in understanding the behaviour and fate of these compounds as important aquatic herbicides, and in assessing the role of seston in adsorption and transport of phosphates and other organic pollutants in surface waters.

An integrated aquaculture system for the treatment of wastewater.

Peter M. Nuttall, Dandenong Valley Authority

A field-trial aquaculture system for the purification of wastewater is described.

The initial aim of the system was to achieve significant and continuous macronutrient and phytoplankton removal from secondary treated sewage effluent discharged to a watercourse. Over a period of one year, only on two occasions was high nitrification achieved.

Uptake of macronutrients occured in a cover of floating plants with up to 2.6% dry weight assimilated as phosphorus. There is a relationship between nutrient uptake and nutrient availability. However chemical monitoring revealed a difference of at best 2.5 mg/l TP between inlet and outlet.

Phytoplankton removal as chlorophyll-A was good.

Although harvesting of plants is necessary to remove assimilated nutrients, a reduction in the plant cover affected the incidence of phytoplankton, as well as reducing the available immersed substrate for microbial attachment important in nitrification processes.

It is unlikely that denitrification contributed to overall amonia-nitrogen removal.

The composition of macroinvertebrates in the system is similar to that of the waste stabilization ponds from which the effluent is derived. The role of aquatic invertebrates is recognised as an important sink for nutrient removal through trophic levels to fish, bioconcentration of contaminants and removal through the emergence of adult aquatic insects.

Silver perch (Bidyanus bidyanus), goldfish (Carassius auratus) and freshwater crayfish (Cherax destructor) survival and growth in the system are being monitored. The acquaculture of fish in the system is seen as a hatchery role rather than a source for direct marketing.

Treatment of wastewater using aquatic macrophytes

Max Finlayson, CSIRO Division of Irrigation Research
Griffith, N.S.W.

The potential of three emergent aquatic plant species *Typha*, *Phragmites* and *Schoenoplectus* to treat effluent from a poultry abattoir was evaluated in a short-term experiment. Effluent was allowed to percolate through plastic lined gravel trenches and the quality of the inflowing and outflowing effluent compared. This showed that the trench systems successfully reduced the suspended solids, turbidity, nitrogen and phosphorus concentration of the effluent while maintaining an acceptable pH and in the case of *Phragmites* and *Schoenoplectus* oxygenating the anaerobic inflow.

The role of the plants in the treatment processes is discussed in terms of tissue nutrient accumulation and water loss by transpiration. These results are used as a basis for describing future work with different effluents and the management options for this type of treatment system.

Recognition of carp x goldfish hybrids:

electrophoretic and morphological evidence

Margrit Keck, Department of Zoology, University of Adelaide,

The objectives of this study were to develop reliable methods for the identification of carp x goldfish hybrids, determine whether there is evidence for introgression, and to examine the conventional idea that F_1 hybrids are intermediate in size and shape between their parents. Electrophoretic and morphological studies were involved.

Investigation of 19 protein systems yielded seven loci which could be used as electrophoretic markers for identification of hybrids, namely adenylate kinase (AK), phospho-gluco-mutase (PGM-1), lactate dehydrogenase (LDH-1), glutamate-oxaloacetate transaminase (GOT-1 and GOT-2). Sixty-eight fishes from cohabiting populations of carp and goldfish were screened for these loci, and on the basis of observed electrophoretic patterns 13 F_1 hybrids, 49 carp and six goldfish were identified. There was no evidence for introgression.

Morphological analysis of samples of known carp, goldfish, and hybrids was based on 26 morphometric and meristic characters. Hubbs' Hybrid Index and Discriminant Analysis demonstrated that F_1 hybrids did not show strict morphological intermediacy, but tended to resemble carp. Because the assumption of hybrid intermediacy is not invoked, these results have important implications for identification of hybrids of unknown genetic history.

Feeding ecology of the european carp (*Cyprinus carpio* L.) in Lake Alexandrina and the Lower River Murray, S.A.

David Hall, Tea Tree Gully S.A.

Analysis of the gut contents of 131 carp, length 150 mm - 770 mm, showed that the diet was made up largely of filamentous algae, detritus, cladocerans, copepods, and amphipods, with lesser quantitites of chironomids and molluscs. Corixids, shrimps and rotifers were not eaten when available. Size class separation, in terms of taxonomic and prey-size categories, was significant in April and July, but minor in September. In April and July, cladocerans were only important to fish smaller than 250 mm. In these months, larger fish ate predominantly copepods, and lesser numbers of amphipods. The inter gill raker distance of fish larger than 250 mm was too large to capture small cladocera, but was small enough to capture copepods, amphipods and Daphnia. In September, Daphnia was predominant in each size class in the lake but was absent from the diet of river fish, which ate predominantly filamentous algae and detritus. While the resource is not always shared equally by each size class, the general diet of carp is largely a reflection of the food available.

Status of carp *(Cyprinus carpio)* in Victoria:

I. Past, Present, and Future.
II. Biotic Interactions.
III. Growth and Reproduction.

Douglas J. Hume, Andrea R. Fletcher and Alexander K. Morison

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I. Past, present and future.

Douglas J. Hume

Some confusion exists regarding the dates of the earliest introductions of carp into Australian waters, but they are thought to be from around the late 1850s to 1908. It was not until 1961-62 that a new strain of carp was introduced to Gippsland and eventually spread throughout south-eastern Australia.

Numbers of carp apparently have declined since the "boom" years in the late 1960s and early 1970s. This reduction has been reflected in commercial catches recorded throughout Victoria and in studies conducted by the Carp Program in the Goulburn River Valley.

Research conducted by the Carp Program, since 1979, has been aimed at determining the distribution, abundance, and life history patterns of carp as well as determining the effects of carp on the aquatic environment. Some results of this research, including management recommendations, will be discussed.

II. Biotic Interactions.

Andrea R. Fletcher

Fish communities containing carp are considered with respect to competition and predation interactions. Carp was dominant at most sites sampled by the Carp Program. Two other introduced species, goldfish and redfin, also occurred in high numbers. Several small native species were secondary in number at most sites but large native fish were rare. The diets provided evidence of food overlap and existence of predators. The main food items of carp were invertebrates. These consisted of microcrustaceans and aquatic and larval insects, from midwater or benthal areas depending on availability at each site. Plant matter was only eaten in minor proportions by a few large carp. The diet of carp overlapped with goldfish, smelt and western carp gudgeons. Small carp were prey items for redfin, murray cod and golden perch. These predators also consumed other smaller fish, and macrocrustaceans.

The evidence for carp being responsible for physical destruction of aquatic habitats is considered. Carp seemed to rarely uproot or directly consume macrophytes. Some physical disturbances may occur when large numbers of carp are present, as indicated by a comparison of vegetation between billabongs. A comparison of turbidity values from all permanent sites and in experimental ponds did not support the contention that carp disturb bottom sediments and increase turbidity. This is partly explained by the persistence of carp in feeding on midwater items more than on the benthos. With current densities of carp, fluctuating water levels may be a more important determinant of both turbidity and the extent of aquatic vegetation communities.

III. Growth and Reproduction.

Alexander K. Morison

The spawning success of carp varied markedly between the sites sampled by the Carp Program and between successive years. In Loch Garry, a large river-plain billabong, spawning only occurred in 1981, a year of winter flooding. In the Broken River spawning occurred in successive years independently of flooding. In Lake Cooper, a shallow, brackish lake, successful spawnings were observed each year and a multiple spawning occurred in 1979. The timing, frequency, and duration, of spawning activity of other fish species in the different water-bodies will be compared.

Growth rates of 0+ carp in Lake Cooper averaged 0.7mm/day over the main growing season and 0.5mm/day for their first twelve months. In Loch Garry, in a year of low water levels, the growth rate of 0+ fish averaged 0.1mm/day while there was no significant growth of 1+ fish. There was no seasonal change in the condition factor of these fish and no annulus was produced in their scales. The implication of this for ageing older fish will be discussed. In the spring following winter flooding, growth rates for these two year classes were both 017mm/day. In the Broken River, 0+ fish showed similar growth rates in both years. Growth of other species in these waterbodies will be discussed.

The impact of the introduced mosquitofish on the native fish of the River Murray.

L. Lloyd - Department of Zoology, University of Adelaide.

The Mosquitofish, *Gambusia affinis*, is a small poeciliid fish native to central America which has been distributed worldwide as a mosquito control agent. It was introduced into Australia in the 1920's and has become an ubiquitous fish in inland waters. It has been implicated in overseas studies in the decline of native fish populations and circumstantial evidence may implicate *Gambusia* in the decline of some Australian native fish. Studies are currently being carried out in South Australia to investigate the possibility of adverse impact of *Gambusia* on native fish such as Pigmy Perch *(Nannoperca australia)* and Rainbowfish *(Melanotaenia fluviatilus)* through both field and experimental work.

Differences in shape of Tasmanian water pennies (Coleoptera-Psephenidae) Are they related to environmental differences?

J.A. Davis (formerly Smith)
The University of Western Australia, Nedlands, W.A.

A taxonomic study of the Australian Psephenidae has revealed the existence of considerable variation in the shape of the larval shield. Such variation is particularly evident within the most common Tasmanian species, *Sclerocyphon secretus*. A multivariate statistical analysis has been undertaken in an attempt to reveal the nature of variation in this Tasmanian species and to define the possible influence of environmental factors on the expression of larval shape.

A preliminary survey of the invertebrates of the River Dee (Central Queensland) in relation to the possible effects of copper mining.

A.P. Mackey, Biology Department, Capricornia Institute of Advanced Education, Rockhampton, Queensland.

The Dee is an intermittantly flowing river that has been subject to the effluent from a copper mine for a number of years. In an initial attempt to observe the effects, if any, that copper mining may have had on the macroinvertebrates in the river, a longitudinal faunal survey was conducted.

Sampling was carried out at one site upstream and several sites downstream of the mine effluent. The number of invertebrate taxa was clearly depleted downstream of the effluent and this was associated with marked changes in the copper concentration in the water, and water pH. By approx, 22 km.

downstream of the effluent, water quality had improved and the invertebrate fauna had begun to recover but even 46 km. downstream of the effluent, the fauna had still not fully recovered; this was best demonstrated by the absence of molluscs.

Further work may make it possible to identify a disappearance sequence of invertebrate taxa characteristic of this type of pollution and this in turn may lead to the recognition of indicator groups, or species, of use in the biological monitoring of mine effluents.

Changes in the Composition of macroinvertebrate fauna drifting into a zinc polluted river.

Tony Sharley, Applied Sciences,
Canberra College of Advanced Education, Belconnen.

Drifting macroinvertebrates were sampled in Ballallaba Creek and in the zinc polluted Molonglo River above and below Ballallaba Creek. Ballallaba Creek which had only 'trace' levels of total zinc (0.25 mg l^{-1}) had 10 orders of macroinvertebrate present. The Molonglo downstream (2.2 mg l^{-1} Zn) and upstream (4.4 mg l^{-1} Zn) had 7 and 5 orders present respectively. The mayfly larvae *Caenidae*, beetle larvae *Helminthidae*, midge larvae *Chironomidae* and blackfly larvae *Simuliidae* all responded to the concentration of zinc in the Molongo River as indicated by a reduction in their drift density. The numbers of stonefly nymphs of the *Gripopterygidae* and caddisfly larvae of the *Hydroptilidae* did not show any modification in their drift behaviour, indicating their tolerance to the present Zn levels.

The use of plastic enclosures to study trace metal cycling in billabongs in the Magela Creek System, Northern Australia.

Michael Jones, Water Studies Centre,
Chisolm Institute of Technology, Caulfield East.

Plastic enclosures have been used to obtain information on the cycling of the trace metals Mn, Zn and Cu in Northern Australian billabongs. In this paper we will discuss the results of enclosure experiments in two different billabong types : Gulungul billabong - a shallow, rather turbid backflow billabong, and Island billabong - a deeper, clear channel billabong. Evidence will be presented to show that the main mechanisms for trace metal removal from the water column are quite different in these two billabongs.

Biology of the water lily *Nymphaea Gigantea* in relation to radium pollution

Alexander R. Williams, Lucas Heights Research Laboratories, Sutherland.

The water lily *Nymphaea gigantea* sens. lat. is a major aquatic macrophyte and a traditional Aboriginal dietary item in Magela Creek, Northern Territory, a catchment which drains two large uranium deposits. At least two distinct taxa can be distinguished among Magela collections, with hybrids, and an apparently sympatric distribution. Flowering and leaf production occur continuously throughout the growing season, and are limited only by water availability. In shallow waters, there is annual recruitment from seed, followed by drought death of the rhizome, but perennial rhizomes develop in deep waters.

Productivity is estimated to be in the region of 500 g m^{-2} y^{-1}; birds feed on the fruit and seeds, buffalo consume whole plants, but the only other native consumers of foliage are detritivores which feed on senescing leaves. Average leaf life is $\sim$ 60 days, the period between flowers is $\geq$ 4 days with an individual flower life of 4 days, and seeds mature after another 8 days. The stable age distribution of foliage organs on mature plants is 4 flower buds, 1 open flower, 2 fruits and 15-30 leaves, all produced from a single apical meristem. The presence of *N. gigantea* can cause up to 60% light interception but it provides considerable aeration of sediment. A minimum foliage surface area is exposed to epiphyte development.

N. gigantea concentrates radium by a factor of $\sim$ 10 in its foliage and a factor of $\sim$ 70 in its rhizome, which is not exceptional. It would contribute only a few percent of the dose to humans received from ^{226}Ra in uranium mining effluent; major contributions will come from fish and mussel flesh. However, since it may be of importance in the long-term biogeochemical cycling of ^{226}Ra, basic data for studying this problem are provided.

Production and demography in *Typha orientalis*

J. Roberts, The University of Adelaide, Adelaide S.A.

Net annual primary production (NAPP) of shoots of *Typha orientalis* was determined from fortnightly harvests of live and dead standing crop between June 1980 and May 1981, near Griffith, in western New South Wales. Live standing crop followed a cycle typical of temperate climate *Typha* spp, reaching a mid-summer maximum of 1316 g m^{-2} dry weight. NAPP was found to be 3717 g m^{-2} dry weight, and continued throughout the year. Based on data from 4 permanent quadrats for the same time period the longevity and survival of shoots and leaves is used to show how the balance between growth and mortality determines live standing crop. Unpublished data of below ground standing crop of *T. orientalis* in the same area, is used to modify the original estimates of net annual shoot production and derive an approximate estimate of whole plant production.

Lake Moondarra (Mount Isa, Queensland) changes following biological control of *Salvinia*.

Tony Orr, Biological Sciences, James Cook University, Townsville Qld.

Changes in the hydrobiology of Lake Moondarra have been monitored subsequent to the introduction of *Crytobagous singularis* to control the aquatic weed *Salvinia molesta*. Special attention has been directed towards macro nutrients in the lake waters and their effects on plant biota, especially phytoplankton. No evidence of a major buildup of N and P was noted during decomposition of the *Salvinia* mat, and significant algal blooms did not occur. There was, however, a rapid increase in the standing crop of the rooted macrophyte *Myriophyllum verrucosum*. The importance of these observations in relation to the ecology of the lake will be discussed.

Hydrology and nutrient loading in Lake Joondalup, a eutrophic lake in south-western Australia.

R.A. Congdon, Botany Department, Monash University, Wellington Road, Clayton, Victoria.

The water and nutrient budgets of Lake Joondalup, 32 km north of Perth W.A., were investigated over a 27 month period from September 1978 to December 1980 to provide guide-lines for the management of the lake.

As a consequence of the mediterranean climate, the lake experiences large seasonal fluctuations in volume. Evaporation decreases the volume over summer and autumn, while rainfall and run-off increases it over winter and spring. Swamps to the south of the lake accounted for 88% of the surface discharge into the lake during 1980, with the remaining 12% coming from stormwater. There is no surface flow from the lake, and groundwater contributed a net input.

The southern swamps supplied some 73% of the external phosphorus loading to the lake, rainfall 26% and stormwater only 1%. Seventy-eight per cent of this input was lost to the sediment and metaphyton, and uptake by macrophytes. The large phosphorus loading from the swamps stimulates blooms of the blue-green 'alga' (Cyanobacteria) *Anabaena spiroides*.

Rainfall is the most important nitrogen input, supplying 69% of the external loading. The swamps supply 30% and stormwater about 1%. A net loss of nitrogen was recorded from the lake water column.

BOOK REVIEW

LAKES AND RIVERS OF AUSTRALIA by V. Serventy and R. Raymond. Published by Summit Books. Available from ACF Conservation Books, 22 Vista Avenue, Ringwood East, Victoria 3135 at $5.00 (plus postage).

Reviewed by W.D. Williams

This is undoubtedly the very best book that has yet appeared on the natural history of Australian inland waters and their biota. That it has received so little attention from professional limnologists I find surprising; perhaps the lack of advertisements in the serious literature explains it (Search is a hopeless avenue for those wishing critiques of recent books on Australian environments). But, whatever the explanation, no freshwater biologist, natural history teacher, limnologist or angler in Australia should be without his own personal copy of this admirable book. At $5.00 (my copy was purchased from ACF Conservation Books at a reduced rate) the book represents the best value for money for many a year. I hope this short review will draw the attention of my limnological colleagues to the book and accelerate its sales.

In 160 pages, a multitude of excellent coloured figures and numerous black and white diagrams, Serventy and Raymond deal with all major elements of the aquatic biota, and briefly describe the two basic sorts of inland environments: rivers and lakes. Additionally, they also deal with estuaries and tidal lagoons in a short chapter. This is not a book for use as a text by undergraduate limnologists; but it is a book that the many Australians enchanted by the diversity and uniqueness of Australian waters and their life will enjoy owning.